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ABSTRACT

This document notes that the traditional elementary school mathematics curriculum focused on computation. Data from the National Assessment of Educational Progress and other tests in states where minimum competencies have been established are thought to indicate computation-oriented curriculum has not produced the desired results. Further, the availability of microcomputers and calculators is viewed to nullify this curriculum approach. The program described here was scheduled for implementation at the P.K. Yonge Laboratory School during 1981-82 school year. It presents a plan for a mathematics curriculum which de-emphasizes computational skills and focuses on several topics (especially problem solving) not currently emphasized. The general format of each grade level guide is a descriptive statement about each relevant curriculum strand at the given grade followed by goal statements, list of materials and activities, and a space for evaluating teaching techniques and pupil performance. (MP)

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A PLAN FOR A MATHEMATICS CURRICULUM WITH A FOCUS ON PROBLEM SOLVING FOR ELEMENTARY GRADES K-5

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Summer 1981

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INTRODUCTION

Traditionally, the elementary school mathematics curriculum has focused on computation, with the major portion of time allocated for mathematics being spent on the acquistion and maintenance of computational skills. Hours spent in drill in a particular computational algorithm has been followed by solving word problems which provided practice in the same algorithm. Data from the National Assessment of Educational Progress and student test scores in states where minimum competencies have been established indicate that this kind of curriculum has not produced the desired results. Moreover, with the availability of hand-held calculators and microcomputers, a computation-based curriculum can no longer be justified.

The people who will enter the twenty-first century as young adults are currently enrolled in our elementary schools. Our current mathematics program must equip individuals for living in the next century. In view of these future needs and the wealth of technological aids now available, curricular change is imperative for the elementary school mathematics program.

RATIONALE

The purpose of this document is to present a plan for a mathematics curriculum, for kindergarten through grade five, which deemphasized computational skills and focuses on several topics not currently emphasizes in the curriculum. The program described here will be implemented in both sections of kindergarten through fifth grade at the P. K. Yonge Laboratory School during the 1981-1982 school year.

One basis for this curriculum development and modification is the statement of ten basic skills specified by the National Council of Supervisors of Mathematics in 1977. The list of basic skills follows:

Problem solving

Applying mathematics to everyday situations

Alertness to reasonableness of results

Estimation and approximation

Appropriate computational skills

Geometry

Measurement

Reading, interpreting and constructing tables, charts, and graphs

Using mathematics to predict

Computer literacy

Another influence on this curriculum guide was the National Council of Teachers of Mathematics (NCTM) recommendations in An Agenda for Action (1980). The NCTM list includes recommendations to:

(1) Make problem solving the focus of school mathematics in the 1980's.

(2) Define basic skills in mathematics to encompass more than computational facility.

(3) Take full advantage of the power of calculators and microcomputers in mathematics programs at all grade levels.

This curriculum direction was also influenced by Wheatley's "Calculators in the Classroom: A Proposal for Curricular Change." In this article he proposes to eliminate the teaching of complex computations in elementary school and to emphasize such topics as problem-solving, geometry, and probability. He would also insist on the mastery of basic facts, stress the concepts of addition, subtraction, multiplication, and division, and strive for computer literacy and skills in estimation and mental arithmetic.

PHILOSOPHY AND GOALS

In the statement of Values, Beliefs, and Goals of P. K. Yonge Laboratory School are listed six goals which the faculty holds for students.

These goals are:

1. That each student develop increasingly positive perceptions of himself.

2. That each student become an effective life-long learner

3. That each student accept increasing responsibility for his own behavior and learning.

4. That each student develop those skills and attitudes necessary for effective group living and interaction.

5. That each student learn to adapt to change and effect change constructively.

6. That each student find real meaning for his life.

In addition to the above goals, this faculty values the individual differences of children and tries to offer a program which provides for these differences. We believe that classroom instruction should include both total and small group as well as individualized instruction. Since children have different learning styles, a wide variety of activities, materials, and teaching strategies should be used in the classroom. Children must experience their own learning. In order to be conductive to learning, the classroom atmosphere must cause children to feel respected, safe, important, capable, unhurried, loved, and free from anxiety.

In mathematics, we believe the program should be individualized to the extent possible, but it should also provide for small group activities and total group instruction, discussions, and interaction. Many activities with concrete objects and much modeling should precede the presentation of abstractions. Manipulatives should be used extensively at both the upper and lower elementary levels. We believe that mathematics should be enjoyable, exciting, and real for children. Unnecessary drill in computation should be eliminated. Since calculators and microcomputers are so prevalent in our society, they should certainly be included in the mathematics program.

We believe children should be encouraged to explore and try many approaches in mathematics, discovering several ways to attack the same problem. It is even more important for them to learn that it is all right to get a wrong answer; simply try a different approach. Children will not develop anxiety about mathematics if they are given tasks appropriate for their readiness, if they are given the time and encouragement to explore several ways to complete the task, and if they feel no threat or disapproval because of a wrong answer. Our prime goal is for children to have positive attitudes about themselves and about mathematics.

POSITION STATEMENTS

In the mathematics program described in this document, there are several concepts, aids, and ideas, though not included in traditional programs, which are significant enough to be discussed apart from the specific content of the program. Therefore, position statements have been prepared on problem-solving; computation; and the use of manipulatives, calculators, and microcomputers.

Problem Solving

The National Council of Teachers of Mathematics (NCTM) has recommended that problem solving be the focus of school mathematics in the 1980's. Concurring with this recommendation, the P. K. Yonge faculty considers it of utmost importance that children learn strategies of problem solving and develop the confidence to apply them to new situations. Teachers will, therefore, emphasize problem solving skills by encouraging children to question, explore, estimate, experiment and suggest explanations. As a result, children will acquire the reasoning ability and creative thought process necessary to solve problems rather than relying solely on rules and formulas.

Computation

In the past, the major part of the elementary school mathematics program has been computation. Much time was spent on adding long columns of numbers and multiplying or dividing by a two-or-more digit number. Those skills are now obsolete since calculators can be used for more rapid and accurate computation. Consequently, computations with paper and pencil should be eliminated from the curriculum, but much time should be devoted to learning the basic facts and concepts of addition, subtraction, multiplication, and division. The de-emphasis of complex computations has also been recommended by NCTM.

Use of Manipulatives

Because abstract mathematical ideas are most easily and completely understood when children can work out principles with concrete materials, the use of manipulatives is imperative in kindergarten through fifth grade. Since more and more research studies indicate that the learning styles of children are a significant factor in how they learn, various teaching strategies and materials must be used to provide for different learning styles. Teachers will use a wide variety of materials in all strands of

the program at all grade levels to help children feel, see, build, experience, model, and touch representations of concepts and situations. Unifix cubes, Chip Trading sets, parquetry blocks, number lines, pattern blocks, and puzzles and games are some of the manipulatives considered to be essential.

Use of Calculators

With the availability of calculators comes the need to re-examine the computational skills needed by every person. Everyone needs to know the basic facts; to understand the concepts of addition, subtraction, multiplication, and division; and to have skill in estimation and mental arithmetic. However, lengthy computations which have no educational value should be done with a calculator. The recommendations of NCTM include a statement that calculators should be available for appropriate use at all grade levels.

The Use of Computers

The NCTM recommends that: "With the increasing availability of microcomputers at increasing costs, it is imperative that schools play an active part in preparing students of the 1980's to live in a world in which more and more functions are being performed by computers."

Many children have microcomputers in their homes; others encounter them everyday in offices and businesses. The elementary school mathematics curriculum must provide opportunities for children to become familiar with computers, to learn what tasks computers can perform, and how to write programs.

DESCRIPTION OF PROGRAM

The mathematics curriculum for kindergarten through grade five which is being developed and tested at P. K. Yonge Laboratory School will provide children with a much broader base of mathematical experiences and skills than the computationally-oriented curriculum of the past. The content areas of the new curriculum were determined from the skills indentified as necessary for all citizens by the National Council of Teachers of Mathematics. The curriculum is composed of eight strands which are found at each grade level (except kindergarten, where six of the eight strands are developed.) This curriculum of eight strands is in sharp contrast to the traditional curriculum which focuses primarily on the arithmetic strand alone.

The table which follows shows the eight strands and the time allocation in weeks at each grade level for each strand. The total of thirty-two weeks rather than thirty-six was planned to allow for normal variances from the instructional program, such as the first and last weeks of school and assemblies.

The time allocation indicates the number of weeks for which the focus of instruction will be on that strand. From time-to time during the year additional instruction in that strand will be appropriately interwoven with instruction in another strand. Variety of activities and topics is important during a given week or day in mathematics. For example, during a five-week period when the major focus is problem solving, a part of each week or each class period might be spent on computation or estimation or spatial visualization. During the major focus on geometry, problem-solving activities might occur.

STRANDS IN ELEMENTARY SCHOOL MATHEMATICS AND TIME ALLOCATIONS IN WEEKS

Strands	Grades					
	K	1	2	3	4	5
Problem Solving	3	5	5	5	5	5
Geometry/Measurement/Graphing	4	3	3	4	6	5
Spatial Visualization	2	1	1	1	1	1
Probability	0	1	1	2	2	2
Computer Literacy	0	1	1	1	3	3
Numeration & Place Value	4	4	7	2	2	2
Estimation and Mental Arithmetic	1	2	2	2	2	2
Arithmetic	(18)	(15)	(12)	(15)	(11)	(12)
Concepts-Principles	17	10	6	8	4	3
Computational Procedures	0	3	3	4	3	5
Facts	0	1	2	2	3	2
Applications	1	1	1	1	1	2
	32	32	32	32	32	32

The order in which the strands are studied will vary with the grade level and individual classrooms. Teachers of all grades, except kindergarten and first grade, agreed that the problem-solving unit should be taught first.

A definitive statement for each strand follows.

Problem Solving

Kantowski defines a problem as "a situation for which the individual who confronts it has no algorithm that will guarantee a solution." Problem solving, then, is the process of finding an algorithm to guarantee a solution. Stated differently, problem solving is what you do when you do not know what to do. The definition of problem solving has at times been limited to describing "word problems" or "story problems" and to the application of a computational skill to a situation where the process is obvious. Problem solving, in this document, refers to the broader definition rather than the limited one.

There are several problem-solving strategies which children should understand. These strategies should be taught at the beginning of the problem-solving unit, one at a time, with many problems for children to try. Problem-solving strategies are learned by solving problems. A frequent reaction to a problem is, "I don't know what to do." Therefore, nothing is done. Familiarity with problem-solving strategies gives children several choices of what to do for a solution. Some of the strategies are: MAKE A LIST, LOOK FOR A PATTERN, GUESS AND TEST, DRAW A DIAGRAM, BREAK INTO PARTS, SIMPLIFY, and WORK BACKWARDS.

Exploration by children is an important aspect of problem solving. Teams of children (perhaps three per team) work well together in exploring. Problems that can be interpreted in more than one way and problems with more than one solution should be presented. Discussion of the processes should always be a part of classroom work. Individual children should be asked to explain how they solved the problem.

Since children are to discover a process to solve a problem, the teacher should ask leading questions to help in the discovery process rather than show and explain a solution. Initially, there should be no focus on the written organization of the work. Later, this should be strongly emphasized.

The goal of the problem-solving unit is for children to feel capable of selecting a process to apply to a new situation; test the solution; and, feeling no threat if they are wrong, select a different process.

Geometry / Measurement / Graphing

Geometry ranges from drawing and identifying shapes in the lower grades to drawing, constructing, and identifying points, lines, line segments, rays, angles, triangles and other polygons, circles, prisms, cylinders, cones, and spheres in the upper grades. The extensive use of manipulatives and models is recommended.

Measurement should actively involve children in the actual measuring process. Standard and non-standard units and metric and non-metric units should be used. In the lower grades, linear and liquid measures and the measure of time and temperature are to be studied. In addition to these topics, the upper grades are to work with perimeters, areas, and volumes.

Graphing is a way to represent quantities pictorially. Children should understand that a shape or a picture may be used to represent a number of items. Graphing should include (at the appropriate place) the reading and construction of bar graphs, picture graphs, line graphs, and circle graphs as well as plotting points in the coordinate system. Children should be appropriately involved in the collection, organization, and interpretation of data.

Spatial Visualization

The development of skills in spatial visualization has often been neglected, even though many everyday activities (fitting tiles on a floor, cutting a dress pattern, cutting and stacking wood) demand the ability to visualize. Walter observes that children who do not easily use the standard verbal learning techniques often excel at solving visual problems. The purpose of this strand is to provide for the development of these right-hemisphere skills through a variety of concrete experiences with puzzles, blocks, tesselations, tangrams, and others.

Probability

Beginning in the first grade children need experience in thinking in terms of probability or how likely it is that an event will happen. In the past, emphasis on probability has been delayed until middle or high school. Elementary school children can observe outcomes of repeated activities and predict possible outcomes by using spinners, tossing coins, throwing dice, or selecting colored blocks from a box as well as many other activities. Experience in this kind of thinking should be provided earlier than it has been previously.

Computer Literacy

In the computer literacy strand, children will develop an awareness of computers and a familiarity with their present and future uses. Hands-on experiences with microcomputers and programming will be included. The level of difficulty of the programs depends on the grade level and the aptitude and readiness of the individual.

Numeration and Place Value

The content of this strand will be the traditional content of recognizing, naming, and writing numerals, emphasis on manipulatives such as Unifix materials and the Chip Trading activities to reinforce concepts is increased. The study of other bases takes on greater importance with the prevalence of computers. The Chip Trading activities are excellent readiness activities for and aids in developing the study of bases two, five, eight, and sixteen.

Estimation and Mental Arithmetic

Skills in estimation of computations and facility in mental arithmetic enables a person to approximate answers and to determine the reasonableness of results. Estimation should also include skills in approximating size, time, distance, and quantity as well as in rounding numbers. Mental arithmetic refers to mental facility with simple basic computations. Appropriate experience is provided at all grade levels.

Arithmetic

The content of this strand has composed eighty to ninety percent of the elementary school mathematics curriculum in the past. In the curriculum being described, the arithmetic strand is less than half the program at each grade level except kindergarten. The decreased emphasis of complex computations allows for more topics to be included in the curriculum.

The arithmetic strand has been separated into four components: concepts and principles, computational procedures, facts, and applications. In kindergarten, only two of the components are developed-concepts and principles and applications. Readiness is an important concept in kindergarten. It includes those mathmatical experiences the child has before he begins working with numerals such as the skills, concepts, and vocabulary necessary to succed in matching, classifying, patterning, and counting with manipulatives. Another part of readiness at the kindergarten level is preparation for paper work such as locating tops, middle, and bottom of a page and learning to circle, underline, and draw lines from one picture to another.

At the other grades, concepts and principles include the meanings of the four arithmetic operations (addition, subtraction, multiplication, and division), their properties (commutative, associative, and distributive) and other properties of our number system.

The computational procedures component focuses on the computation algorithms for whole numbers, fractions, and decimals

at the appropriate level. The understanding of the concept of the operation is more important than unnecessary drill in a lenghty algorithm. It has already been stated that complex computations will be eliminated from the K - 5 curriculum. Specifically, multiplication and division by two or more digits and addition of fractions with unlike denominators will be eliminated. Cumbersome computations will be performed with calculators.

It is imperative that children learn the basic facts (9 + 5 = 14, 8 x 6 = 48). Many and varied activities should be directed to helping children learn basic facts, beginning in first grade.

One important reason for studying mathematics is its usefulness in application. Using computational facility and understanding in practical situations is an important aspect of the arithmetic strand and should not be overlooked. Children need to see how mathematics can be useful in situations in their lives.

CURRICULUM GUIDES

A curriculum guide has been written for each grade level, kindergarten through grade five. These guides will be used in the implementation of the program. The general format of the guides is a descriptive statement about each strand at a given grade level followed by goal statements, a list of materials and activities to be used, and a space for evaluating the teaching techniques and student performance.

STRAND

Descriptive Statement

Goals

Materials / Activities

Evaluation

The curriculum guide for kindergarten is slightly different because the kindergarten curriculum includes more readiness activities than the other grades. There is more intermingling of the strands and of the concepts within a strand at this level than in the upper grades.

These guides are tentative, a first draft written for use only by the P. K. Yonge elementary faculty. Continuous evaluation and revisions will be made during the year as the new curriculum is implemented. A second draft next summer, 1962, will reflect these revisions and more consistency of format, especially in the listing of materials and activities.

MATH CURRICULUM FOR KINDERGARTEN

This curriculum is organized around six of the eight strands. Probability and Computer Literacy are not given special treatment.

The list below shows the relative number of weeks devoted to each strand. The strands will not be taught week by week, as is true in some upper grade levels. Rather, skills from several may be interspersed within a week and even within a given math period.

Problem Solving	3 Weeks
Numeration and Place Value	4 Weeks
Estimation and Mental Arithmetic	1 Week
Geometry/Measurement/Graphing	4 Weeks
Spatial Visualization	2 Weeks
Computer Literacy	0 Weeks
Probability	0 Weeks
Arithmetic	18 Weeks
Concepts and Principles	17 Weeks
Computational Procedures	0 Weeks
Facts	0 Weeks
Applications	1 Week

The chart following is a suggested Yearly Plan of Instruction. It is based on the Scott, Foresman Kindergarten book Mathematics Around Us Skills and Applications Approach (S-F), but could be adapted to other workbooks. References to "H M" mean the Houghton-Mifflin Kindergarten Workbook Mathematics, used as a supplement simply because it was available.

Books by the Addison Wesley Company, the American Book Company's On Target series, and Open Court Company's Real Math series have been suggested as good possibilities for basal or resource use.

To use the Yearly Plan of Instruction, look up the goals and materials listed in the Curriculum Guide for a particular strand. The Curriculum Guide gives detailed objectives (GOALS) and possible materials to use for reaching

the goals. Basal math workbooks, such as the Scott, Foresman, suggest activities using the material.

The Plan of Instruction suggests topics to be covered during one week, allowing about three 20 minute periods per week per strand, where more than one strand is listed for one week. It is expected that math learnings will be reinforced incidentally throughout the day.

Calculators will be used throughout the mathematics program whenever appropriate. The calculator is an additional aid for helping children identify and recognize numerals. With calculators, children can communicate the number concept with numerals before they are able to write numerals.

YEARLY PLAN OF INSTRUCTION

STRAND	PROBLEM SOLVING	ARITHMETIC	NUMERATION & PLACE VALUE	ESTIMATION & MENTAL ARITH. CALCULATOR	GEOMETRY MEASUREMENT	SPATIAL VISUALI-ZATION
Week 1	Pre-Test	Pre-test Number counting	Pre-test numerals		Learn circle	
Week 2		Readiness: Red, yellow, green, Same & different Define sort Sort by object			Learn triangle	
Week 3		Readiness: Blue, orange, brown Sort by use Sort by size			Learn rectangle	
Week 4	Sorting by choice (child's own sort; Teacher sorts, says "How did I sort?)	Readiness: Sort by color Sort by shape			Review: circle, triangle, rectangle	
Week 5	Counting by choice Copy child's model	Concept: Number counting - beads Readiness: Beads Copying teacher's model			Learn square	
Week 6	Bead patterns by choice	Readiness: Beads forming patterns			Learn oval	
Week 7		Readiness: Marking systems on paper 3-D positional			Learn diamond	Jumbo star shaped parquetry

K-3

Week 8		Readiness: Marking locations on paper			Learn hexagon	
Week 9	Seeing patterns	Readiness: Scott, Foresman pp. 1-4				
Week 10	Seeing patterns S-F pp. 5-7	Readiness: Sequence S-F pp. 8				
Week 11			Estimating amts. & lines S-F pp. 9-10	Estimating more & less S-F Pp. 9-10		
Week 12	One-to-one matching	Concept: 1 to 1 match. Same & different numbers S-F pp. 11-12 H-M pp. 29-32				
Week 13		Concept: More, less S-F pp. 13-16				Large parquetry
Week 14		Concept: Numbers 1, 2, 3 S-F pp 17-20	Numerals 1, 2, 3 S-F pp. 17-20	Calculators		
Week 15		Concept: Numbers 4, 5, 0 S-F pp. 21-26	Numerals 4, 5, 0 S-F pp. 21-24 Introduce calendar	Calculators		
Week 16			Numerals that stand for more, less S-F pp. 27-28		Graphing Numbers 0 - 5	
Week 17		Concept: Sequencing numbers 1-5 S-F pp. 30	Sequencing numerals 1 - 5 S-F pp. 29, 31	Calculators		

Week 18	Bead and peg-board patterns by choice and discovery	Concept: Review S-F pp. 32 Concept: Readiness more advanced patterning	Review numerals 1-5 S-F pp. 32			
Week 19	Bead and peg-board patterns by choice and discovery	Concept: S-F pp. 33-36	Numerals 6, 7 S-F pp. 33-36	Calculators		
Week 20	Discover number groupings that make up numbers 6 - 8	Concept: Number 8 S-F pp. 37-38 Concept: More & less S-F pp. 39-40	Numeral 8 S-F pp. 37-38 Greater & lesser numerals S-F pp. 39-40	Calculators		
Week 21		Concept: Numbers 9, 10 S-F pp. 41-44	Numerals 9, 10 S-F pp. 41-44	Calculators	Graphing numbers 0-10	
Week 22		Concept: Sequencing numbers 6 - 10 S-F pp. 45-48	Sequencing numerals 6-10 S-F pp. 45-48	Calculators		
Week 23				Estimating comparative size S-F pp. 49-50	Measurement: Introduce non-standard units of measurement S-F pp. 51-52	
Week 24				Estimating sizes, distances, etc.	Measurement: Work with non-standard units of measurement S-F pp. 53-60	
Week 25		Concept: Numberline S-F pp. 61-63			Measurement: Numberline S-F pp. 61-64.	

Week 26					Review of circle, triangle, rectangle, S-F pp. 65-68 Positional words S-F pp. 69-72	
Week 27		Concept: Half S-F pp. 75-76			Measurement: Perimeter S-F pp. 73-74	
Week 28					Measurement: Area S-F pp. 77-80	Small parquetry
Week 29		Concept: Numbers 11 and 12 S-F pp. 81-84	Place Value: Introduction S-F pp. 81-84	Calculators	Graphing numbers 0 - 12	
Week 30	Use manipulatives to solve problems, make up problems	Concept: Addition, Application: addition S-F pp. 85-86	Recognizing numerals 13-100+ (optional)			
Week 31		Concept: Subtraction, Application: subtraction S-F pp.				
Week 32					Measurement: Time S-F pp. 93-95	
Week 33	Money problems with varying answers	Concept: Money S-F pp. 89-92, 96 Application: Money				

Week 34		Concept: Ordinals 1st, 2nd, last				
Week 35						
Week 36						

PROBLEM SOLVING Grade K

Problem Solving at this level is largely an attitude and way of instructing. Children are encouraged to explore materials and ideas and discover concepts in the other strands. They are given opportunities to invent problems for themselves and each other. Looking for patterns is one problem solving strategy taught.

GOAL 1: To discover several possible ways to sort and classify, to do one-to-one matchings, to combine number groups

MATERIALS: See "Arithmetic, Concepts and Principles, Readiness Goal 1."

GOAL 2: To understand what is meant by a pattern and to practice forming patterns.

MATERIALS: Beads, strings and bead patterns, pegboards and pegs

EVALUATION: Teaching Techniques

Student Performance

GEOMETRY, MEASUREMENT AND GRAPHING

GEOMETRY at the kindergarten level means learning to name the shapes the children see around them, and learning certain positional words.

GOAL 1: To recognize circles, triangles, rectangles, and squares.

MATERIALS: Attribute blocks, flannel board shapes, paper shapes, clay and shape patterns, pipe cleaners; objects with discernible shapes: workbooks, work sheets, coloring book pages, etc.: stories dealing with shapes.

GOAL 2: (Optional) To identify oval, hexagon and diamond.

MATERIALS: Same as Goal 1.

GOAL 3: To identify objects that are above or below a given line, inside or outside a boundary.

MATERIALS: Manipulative objects; flannel board objects, yarn; rope, hoops.

EVALUATION: Teaching Techniques

Student Performance

MEASUREMENT at the kindergarten level gives children experiences with measurement as a counting process.

GOAL 1: To use a uniform unit of measure to compare 2 or more objects.

MATERIALS: Sticks, toothpicks, objects to measure.

GOAL 2: To count non-standard units to determine length, height, or width of an object or picture.

MATERIALS: See Goal 1.

GOAL 3: To measure distances using a numberline.

MATERIALS: Numberline.

GOAL 4: To count non-standard units to determine perimeter and areas.

MATERIALS: See Goal 1, papers, rugs or mats.

GOAL 5: To tell time on the hour on a non-digital clock.

MATERIALS: Demonstration clock, paper plate clock for each child, Hap Palmer song "Paper Clocks".

GOAL 6: To introduce the calendar, including locating a given day, naming the current month and year, and reciting the days of the week.

MATERIALS: Calendar.

EVALUATION: Teaching Techniques

Student Performance

GRAPHING will be a simple introduction to the idea that number changes can be represented pictorially as well as concretely.

GOAL 1: To see number values in graph form.

MATERIALS: Paper ruled off in large squares, as in Houghton-Mifflin pp. 55 or 105, crayons. Other opportunities to use graphing will occur in the science, social studies, and other curricular areas.

EVALUATION: Teaching Techniques

Student Performance

SPATIAL VISUALIZATION

It is particularly important to develop the ability to see shapes and spaces at the kindergarten level. It is developed through manipulation of objects and carefully guided progression of printed pages. The most difficult level of skill is left-right or top-bottom reversals of 2-dimensional figures.

GOAL 1: To develop spatial visualization skills through a variety of concrete experiences.

MATERIALS: Puzzles, parquetry, Unifix Cubes and pattern cards; attribute blocks, building blocks, Konnectos, Bristle Blocks, Legos, and other building materials that can be used to make 3-dimensional forms.

GOAL 2: To transfer 3-dimensional skills to 2-dimensional work.

MATERIALS: Worksheets to develop visual perception, such as the "Frostig Program for the Development of Visual Perception" and Continental Press series "Visual - Motor Skills", "Visual Readiness Skills", and "Seeing Likenesses and Differences".

NUMERATION AND PLACE VALUE

At the kindergarten level, numeration means learning to recognize the numerals 0 through 9 and combining them to recognize 10-12 (minimum) to 100 + (maximum). For those children who recognize the numerals above 10, it includes seeing the pattern of the multiples of 10. Children are introduced to the idea of place value. Calculators are used extensively.

GOAL 1: To recognize the numerals 1 through 5.

MATERIALS: Numeral cards, plastic or wooden numerals, calculators, clay and numeral patterns, sandpaper numerals, and any other material with which children can see and hold, trace, model, or feel numerals: games, puzzles, etc., where children match numbers to numerals by placing objects in numbered boxes or numbered posts, etc.: Unifix cubes inset pattern boards and value boats: workbook pages, dittoed sheets, coloring book pages, etc.: calendar.

GOAL 2: To recognize numeral 0.

MATERIALS: Same as Goal 1.

GOAL 3: To select from two numerals 0 - 5, the one that stands for more, for less.

MATERIALS: Numeral cards: Houghton-Mifflin Pp. 65 or similar worksheet.

GOAL 4: Given numerals 0 - 5, to put numerals in order.

MATERIALS: Numeral cards.

GOAL 5: To recognize numerals 6 through 10.

MATERIALS: Same as Goal 1.

GOAL 6: To tell which of two numerals means more (is greater) or less.

MATERIALS: Numeral cards, dice.

EVALUATION: Teaching Techniques

Student Performance

GOAL 7: To recognize numerals 11 and 12.

MATERIALS: Same as Goal 1: Clock.

GOAL 8: To introduce the idea of place value.

MATERIALS: Egg carton with two cells cut off; counting objects that do not roll.

GOAL 9: To sequence numerals 0 - 12.

MATERIALS: Numeral cards, dot-to-dot sheets, numeral lacing cards.

GOAL 10: (Optional) To recognize numerals 13 - 100+

MATERIALS: Calendar, 100 chart, Unifix 100 Track

EVALUATION: Teaching Techniques

Student Performance

ESTIMATION

Estimation at the Kindergarten level deals mainly with visual estimations. Children estimate more and less, comparative sizes, and approximate distances to be measured in non-standard units.

Calculators are introduced. Children will learn to count by ones and more able children will learn the addition and subtraction functions.

GOAL 1: To guess which of 2 groups or pictures of groups of objects has more or less.

MATERIALS: Small objects

GOAL 2: To look at 2 or 3 objects, moved farther and farther apart, and guess which is shorter/shortest or longer/longest.

MATERIALS: Sticks, books, other objects in the room.

GOAL 3: To look at a distance, length, etc. and guess how many of a given measuring unit will cover it.

MATERIALS: Measuring sticks.

GOAL 4: To learn the purpose of calculators.

MATERIALS: Calculators, calculator practice board.

GOAL 5: (Optional) To learn the symbols +, -, and =, and be able to use them on the calculator.

MATERIALS: Calculators, calculator practice boards.

EVALUATION: **Teaching Techniques**

Student Performance

Concepts and principles are the heart of the kindergarten math program. Seventeen weeks out of thirty-two are devoted to this component of the arithmetic strand. One other component, applications, is given one week, and the other two, facts and computational procedures, are not covered in kindergarten.

The concepts and principles covered are pre-number readiness, understanding cardinal numbers, ordering numbers, addition readiness, subtraction readiness, and money.

I. Concepts and Principles

A. Readiness

GOAL 1: To sort objects according to various criteria. Instruction will include the following concepts:

1. Same and different
2. Recognition of colors
3. Sizes (big / large, bigger/larger, small/little, smaller/littler, middle-sized)
4. Shape -- See Curriculum Guide for Geometry

MATERIALS: Beads, one-inch cubes, teddy bear counters, bottle tops, flat shapes, broken crayons, small building blocks, and other manipulative materials that come in a variety of colors, sizes, and/or shapes. Trays, three or more per child, such as shoe box tops, styrofoam trays fruits and vegetables are packed in, or tops of egg cartons.

GOAL 2: To understand what is meant by the term "pattern", to copy a series set up by the teacher or another child, and

to complete a repeating pattern with two elements.

MATERIALS: Beads, strings, tray to hold beads for each child; for teacher, flannel board shapes and flannel board or magnetic shapes and metal surface; other patterning materials available.

GOAL 3: To copy and form patterns with three or more elements, in both three dimensional and two dimensional forms.

MATERIALS: Beads, strings, bead pattern cards, pegs and peg boards.

GOAL 4: To function on a workbook page. Instruction will include the following concepts:

a. Top, middle, and bottom of a page

b. Tracing lines, drawing lines from picture to picture, underlining, circling, marking an X.

MATERIALS: Cutting and pasting materials, crayons, pencils, work sheets of pictures illustrating the concepts.

B. Number

GOAL 1: To rote count, count objects, and count pictures to 20 (minimum) or 100 + (maximum).

MATERIALS: All kinds of objects that can be moved and counted, including Unifix cubes, counters, sticks, bottle tops, beads, fingers; puzzles where each piece fits into an individual hole and flannel board shapes are good transitional materials from three-dimensional to two-dimensional counting; pictures to count.

GOAL 2: To match one-to-one the members of two different sets.

MATERIALS: Objects such as teddy bears, blocks, and counters to be set on top of each other, flannel board shapes, odd yarn, work sheets of sets with equal numbers, Houghton-Mifflin K math book Pp. 29-32.

GOAL 3: Given two sets, to tell by matching whether the sets contain the same number or, if different number, which has more and which has less.

MATERIALS: See Goals 1 and 2, especially Unifix cubes Houghton-Mifflin Pp. 33-36.

GOAL 4: To recognize sets of 1 - 5.

MATERIALS: See Goals 1 and 2; also common objects in the room such as windows, books, chairs. See also Numeration and Place Value Goal 1.

GOAL 5: To practice recognizing dot patterns for sets 2 - 5.

MATERIALS: Cards with dot patterns, dominoes, dice, coins.

GOAL 6: To understand meaning of zero

MATERIALS: Same as Goal 1. See Curriculum Guide for Numeration and Place Value.

GOAL 7: To sequence pictures of sets of objects

MATERIALS: Number cards (as in Peabody Kit Level P)

GOAL 8: To recognize sets of 6 through 10.

MATERIALS: Same as Goal 4.

GOAL 9: Given 2 sets or pictures of sets, to tell which has more or less.

GOAL 10: To practice sequencing and counting using a number line.

MATERIALS: Number line on floor.

GOAL 11: To recognize one-half.

MATERIALS: Objects that can be used to show halves, such as glasses of water, fruits, clay, straws, sticks, flannel board cut-outs, paper, etc.

GOAL 12: To recognize sets of 11 and 12.

MATERIALS: Same as Goal 4, empty egg cartons.

GOAL 13: To identify ordinals first, second, and last.

MATERIALS: Objects to line up in a "parade", such as people figures, animals or vehicles; work sheets.

C. Addition

GOAL 1: To introduce the idea of addition by taking 2 groups of objects and counting the number of objects altogether.

MATERIALS: Fingers, manipulative counting materials; work sheets, including "blank" sheets with rings drawn in two different colors to show one set with 2 subsets on which children will put counters: Houghton-Mifflin Pp. 109-114. See also section on applications.

D. Subtraction

GOAL 1: To introduce the idea of subtraction by taking a group of objects no larger than 10, removing part of the group, and counting to determine how many are left.

MATERIALS: See Goal 1 under addition; also Houghton-Mifflin Pp. 115-118

E. Money

GOAL 1: To identify the coins penny, nickel and dime.

MATERIALS: Pennies, nickels, and dimes.

GOAL 2: To recognize symbol for cents(¢)

MATERIALS: Chalkboard and chalk; Houghton-Mifflin pp. 120-123.

GOAL 3: To know the value of the penny, nickel, and dime.

MATERIALS: Pennies, nickels, and dimes.

GOAL 4: Given any combination of pennies and/or nickels and/or dimes, to give total value through 10¢ (minimum) or 20¢ (maximum).

MATERIALS: Pennies, nickels, dimes; toys, empty food containers, or other items to be sold; Chip-Trading game chips and tills.

II. Applications

A. Addition

GOAL 1: To solve word problems by counting fingers or objects or by making marks, to sums of six (minimum) or ten (maximum).

MATERIALS: Fingers, counting materials, paper and pencil.

B. Subtraction

GOAL 1: To solve word problems by counting fingers or objects or by making marks.

MATERIALS: See Goal 1 for Addition.

EVALUATION: Teaching Techniques

Student Performance

MATH CURRICULUM FOR FIRST GRADE

The first grade math curriculum is composed of the following strands. The number of weeks allocated to teaching the strands is shown. Although the time allocations are estimates, they indicate the degree of emphasis given each area. A problem solving, or discovery approach will be implemented. Because understanding of math concepts is developed through the manipulation of objects, children will participate in many "hands on" activities. Calculators will be used throughout the program whenever appropriate.

Problem Solving	5 weeks
Numeration and Place Value	4 weeks
Estimation and Mental Arithmetic	2 weeks
Geometry, Measurement & Graphing	3 weeks
Spatial Visualization	1 week
Computer Literacy	1 week
Probability	1 week
Arithmetic	15 weeks
Concepts	10 weeks
Computation	3 weeks
Facts	1 week
Applications	1 week

PROBLEM SOLVING (5 Weeks)

Problem solving is a process, as well as an attitude, that encourages children to explore and analyze. Make a List, Find a Pattern, Guess and Test and Draw a Picture are strategies children can use to find solutions to problems. The teacher models, encourages and reinforces exploratory behavior. Working in small groups permits more student participation.

GOALS:

To encourage exploration and discovery.

To foster experimental attitudes - "I'll try..." instead of "I can't..."

To develop reasoning and independent thinking.

To convey the idea that there can be more than one "right" way to solve a problem and sometimes more than one "right" answer.

To help children relate math concepts to real life.

To apply math knowledge in unknown situations.

MATERIALS:

See "Problem Solving Process" article by Grayson Wheatley.

See Mathematics Learning in Early Childhood, p. 69-93.

See Teacher, Feb. 1981, "Geometry for Young Students in the 80's".

Techniques of Problem Solving Kit (TOPS) - Deck A.

Since problem solving can be incorporated into most of the other strands, the list of concrete materials to use is practically endless, but includes Unifix cubes, Chip Trading, counters of all sorts, Pattern Blocks, parquetry, Tangrams, Cuisinaire rods and cubes, play money, pegboards.

ACTIVITIES:

One of the keys of problem solving is to let the child discover that he can figure it out himself. Therefore, the teacher's role is to ask leading questions, not to explain or demonstrate the solution. The problems should be mixed (not all addition or all subtraction), although it is helpful to work on one strategy at a time. The emphasis is on using the strategy, not just getting the right answer! Following are some examples of problems suitable for each strategy.

Look For A Pattern

Teacher makes a pattern (with Unifix cubes, beads, pasta), repeats it and has child make the pattern again.

More difficult: Teacher makes a pattern repeats it and then partially repeats it again - the child must finish the pattern.

Have children create their own patterns with beads, unifix cubes, pegboards.

Have child complete number patterns: 123123_ _ _, 221221_ _ _, 135_ _ 11, 1121121_ _ _ _2.

"What's My Rule?" game - Explain: "Give me a number and I'll tell you what the rule does to that number. Your job is to listen carefully and find the rule. When you think you know it call "Rule!" Then I'll give you a number and you apply the rule to see if you are right." (Example: Always add 2. 3 gives 5, 7 gives 9, etc.).

Pegboard game - similar to tic-tac-toe - Children take turns placing pegs. To win, you must get 5 of your pegs in a row (down, across or diagnally). Important to develop strategy for blocking opponent.

Make A List

How many numbers are there between 6 and 12? (7, 8, 9, 10, 11).

How many letters come before k in the alphabet? (A, B, C, D, E, F, G, H, I, J).

How many different number sentences can you write with sums of 8?

(1 + 7, 2 + 6, 3 + 5, 4 + 4, 5 + 3, 6 + 2, 7 + 1)

Think of the different ways to have 15¢. Make a table:

Dimes	1	1	0	0	0	0
Nickels	1	0	2	1	0	3
Pennies	0	5	5	10	15	0

How many even numbers are there between 1 and 15? (2, 4, 6, 8, 10, 12, 14)

Draw A Picture - A visual representation of the problem helps children "see" the solution. At the beginning, manipulatives are even better!

You have 16 objects. Make 4 piles so that each one has the same number of objects.

You have 15 objects. How many groups of 3 can you make?

How many different buildings can you make using 6 in each one?

Make 4 uneven stacks of unifix cubes (ex: 6325 or 6613). Now make the stacks even in as few moves as possible.

I have 24 bottles of coke and I want to put them in packs that hold 8. How many packs do I need?

If there are 4 chickens inside the pen and the same number outside of the pen, how many chickens are there?

3 feet of the farmer's fencepost is in the ground and 4 feet are above the ground. How long is the post?

24 children will be seated in rows. There will be 4 children in each row. How many rows will there be?

Dan, Ted and Bill live on the same road. Dan lives 2 miles from Ted. Bill lives 3 miles from Ted. How far does Dan live from Bill?

A friend of mine owns a gas station. This morning 7 cars came in and each car wanted 4 new tires. How many tires did my friend sell?

6 octopi walked into a shoe store and they all needed new shoes. How many shoes did they need?

Guess And Test

I have 11 thank you letters to write. I wrote 4 letters today. How many letters do I have left to write? (guess 3 + 4 = ? Too small or too large? Guess again.)

Which two coins would you add to get the greatest amount of money: quarter, dime, dime, nickel.

Which numbers add up to 25? (encourage estimation - could use the calculator).

Cut out 7 pieces of paper. Put one of these numbers or symbols on each one. How many different number sentences with 3 addends can you write? rearrange and record: 2 9 3 4 = +

_____ + 3 + ____ = 10.

EVALUATION: Teaching Techniques

Student Performance

GEOMETRY, MEASUREMENT AND GRAPHING (3 Weeks):

Geometry

In first grade, children learn to identify basic geometric solids and figures, which enhances their perception and appreciation of the shapes that exist around them.

GOALS: To provide experiences in working with geometric shapes and classifying them according to their features.

To identify circles, squares, rectangles and triangles and to compare them to familiar objects.

MATERIALS/ACTIVITIES:

See Addison Wesley Book 1, p. 266-277.

Commercial materials for working with shapes include parquetry, pattern blocks (Activity Book A), felt shapes for the flannel board, geometric solids, Family of Shape, Cuisinaire rods and cubes, etc.

Children can make shapes using straws, pipe cleaners, wire or modeling clay.

Make shape pictures by gluing precut shapes onto paper.

"Math Match" - a rummy card game. The object is to make books of various shapes.

"What Shape is it?" game - Without looking, children identify shapes by touch.

To recognize shapes in surroundings, play a guessing game: "Fiddledeedum, fiddledeedee, I see something that you don't see, and the shape if it is a square".

Geometric puzzles - Cut shapes in 3-4 inch pieces; put them in an envelope and draw the shape on the envelope. To make the task more challenging, put parts of 2 circles in the same envelope.

Measurement

Through a variety of experiences using concrete objects, children begin to understand that measurement is based on the idea of comparison and that we can use different units of measure for the same object. According to Piaget, a child cannot understand linear measurement until he can conserve length.

GOALS:

To provide experiences that develop children's sense of conservation.

To convey the idea that measurement involves comparison.

To introduce concepts of length, weight, capacity, distance and temperature.

To introduce different units of measure for various types of measurement - rulers, yardstick, scale, measuring cups, thermometer, etc.

MATERIALS/ACTIVITIES::

See Mathematics Learning in Early Childhood p. 228-247. Chapter emphasizes importance of measuring with concrete units of measure - blocks, erasers, paper clips, etc., before attempting to measure something in inches or centimeters. Suggests activities....

See Addison Wesley Book 1, p. 277-87.

Conservation activities - Roll clay into a ball, then a worm. Ask: "Is there more clay in the ball or the worm?" Make two piles with the same number of coins in each, but spread one pile out. Which has more? Make two rows of 10 beans but make one row appear longer.

"Oddity problems" - child is asked to select the odd stimulus out of three, where number is the relevant attribute. This trains children to look more carefully.

Place various objects side by side to compare length - pencils, blocks, crayons, chalk...draw lines on the chalkboard and ask child to point to the longer or shorter, longest or shortest line.

"Picking Straws" game - One child holds 3 straws of different lengths and others draw. Whoever gets the longest straw gets to hold for the next round.

"My Best Guess" - Compare attributes: " What is longer your hand or your foot? What is farther, the office or the cafeteria? What is heavier, a dog or a goat? Who is taller, Bill or Tom?"

Put various objects on the table and arrange them in order, from smallest to largest or shorter to longer

Meaasure and weigh each child.

Measure distances with steps.

Time duration is included in the measurement strand. Telling time on the hour, then to the half-hour, is presented. The concept of time is expanded to include days, months, and seasons.

GOALS:

To tell time on the hour and half-hour.

To name the days of the week.

To name the months of the year.

To name the seasons of the year.

To become familiar with the calendar.

MATERIALS/ACTIVITIES:

See Arithmetic Teacher, March, 1980, "Using an Hour Clock to Teach Time", p. 38-39. Author suggests introducing time telling with hour hand only. Excellent article.

Teaching aids include a demonstration clock, small individual clocks for students to manipulate, regular and digital watches, clock stamps, Tell Time Quizmo flashcards, and clocks children make from paper plates.

Relate time to events (get up, eat lunch, PE, school dismissal.)

"What Time is it?" game - A child sets the demonstration clock and asks "What time is it?" Classmate who answers correctly gets to set the clock next.

Teacher shows the clock and children write the time down

Team game - Child gets a point for his team by correctly telling time shown on clock.

"Show Me!" - Teacher says a time and child shows the time on his own clock.

Living Clock - Have 12 children form a circle, each with a number indicating his hour. Select a child to stand in the center and show a designated time by stretching one hand toward the 12 and the other toward the hour.

Make a Time Book. Draw pictures of daily activities.

Child draws hands on clock stamp to show the appropriate time.

Make flashcards with a clockface on one side and time shown written on the back.

Establish a daily calendar routine.

Children can make their own monthly calendar to take home. Fill in dittoed calendar form, make special dates and decorate.

In addition to their name, children can write the day and date on their workpapers.

Make a book of months. Draw a picture of something child associates with each month - holidays, birthdays, school starts and ends, etc.

Plan a science unit to study the seasons.

Graphing

Graphs are pictorial representations which help children see numerical relationships more clearly. It is important to use concrete objects or pictures for graphing activities before introducing bar graphs.

GOALS: To read and interpret a simple bar graph.

MATERIALS/ACTIVITIES;

See Arithmetic Teacher, Oct., 1979, "Bar Graphs for 5 Year Olds". This article presents activities which progress from concrete to abstract.

See Mathematics Learning in Early Childhood, p. 242-3, 267-9.

Make class graphs of birthday months, hair color, eye color, favorite ice cream flavor, pet color, TV show (keep choices to 2-3; make sure all participate).

Integrate graphing with social studies and science units.

EVALUATION: Teaching Techniques

Student Performance

SPATIAL VISUALIZATION (1 Week)

In this strand, children engage in activities designed to develop perceptual skill, intuitive thought and the ability to visualize. These skills are functions of the less developed right hemisphere of the brain.

GOALS: To promote development of the right hemisphere of the brain.

MATERIALS/ACTIVITIES:

Parquetry blocks and pattern cards

Design cubes and pattern cards

Symmetry patterns

Tangrams

Perceptual Puzzle Blocks

Cuisinaire rods and cubes

Tesselations - glue shapes together in a pattern or trace around templates....dot paper is more advanced

Worksheets to provide practice in visual discrimination.

Make 2 identical cardboard shapes. Ask: "Which of these shapes can be made by the part you have?" Have children rotate their pieces to fit.

EVALUATION: Teaching Techniques

Student Performance

PROBABILITY (1 Week)

When we say that one event is more probable than another, we mean that it is more likely to happen. At first grade level, children are introduced to the likelihood of various events, which is the foundation of probablility theory.

GOALS: To provide readiness for probability experiences.

MATERIALS/ACTIVITIES:

"Marble Game" - Display a box with 5 marbles in it - 2 blue, 1 red, 1 yellow and 1 green. Let a child reach in and pick a marble, without looking. To win, he must select the red one. Ask, "Do you think you are more likely to win or lose? Why? Which color do you have the best chance to pick? Why?"

"Spinner Game" - Prepare a spinner disc; color one third of the area white and two thirds red. Let the children take turns spinning to see where the arrow will land. Ask: "Are you more likely to land on white or red? Why?"

"Toss a Coin Experiment" - Toss a coin 20 times and record whether it lands on heads or tails. Ask: "When the coin is tossed, will the side that it lands on always be either heads or tails? (Yes) Will heads come up on the next toss? (don't know). Can you be sure which side will come up next? (no)"

"Paper Cup Experiment" - Drop a paper cup on the floor 20 times and record whether it lands on its side, upside down or rightside up. What is most likely to happen? Discuss results.

See Mathematics Learning in Early Childhood, p. 86-7, 265 -

COMPUTER LITERACY (1 Week)

Early "hands on" experiences familiarize children with computers and promote confidence in working with them.

GOALS: To become aware of and familiar with computers.

MATERIALS/ACTIVITIES:

Bring a microcomputer and a resource person to the classroom. Tell the children what a microcomputer does and show them how it works.

With assistance, children can program the computer to print their names.

EVALUATION: **Teaching Techniques**

Student Performance

NUMERATION AND PLACE VALUE (4 weeks)

First grade children work with the numbers 0-100, learning to recognize read, write, and count them. They begin to understand that the value of a number depends on its position. The use of manipulatives is essential while children are learning place value, which is one of the most important concepts presented during first grade.

GOALS (Numeration):

To recognize the numerals 0-100.

To write the numerals 0-100.

To know the missing number in a sequence.

To compare two numbers to see which is greater or less.

To count to 100 by 1's, 5's, and 10's.

To count ordinal numbers to tenth.

MATERIALS/ACTIVITIES:

1. See Mathematics in Our World, Book 1, Addison Wesley, p. 11-65, p. 145-158

   Counting experiences - provide a variety of objects to manipulate (cubes, chips, beans, beads, popsickle sticks, counting frame, abacus, bottle caps, poptops, "teddy bears"); count orally - children, chairs, bikes, steps, blocks (use cardinal and ordinal numbers)

   Discover the progression of numbers - number line, hundred chart, calculator counting activities, daily calendar routine, Unifix 100 Track and 1-100 Operation Board; paste numerals from old calendars onto cards; make a number line on the floor with masking tape and walk off distances

   Ordering numbers - have children arrange numeral cards in order; supply missing numeral card from line-up on chalkledge; pass out numeral cards and have children stand in order; fill in number tables; complete dot-to-dot exercises; say "I'm thinking of a number that is one or more than (or less than) 29"; write missing numeral in sequence - 7_9, _4 6; write two numerals on chalkboard and have child circle which is less; sing "99 Bottles of Milk"

   Games - "War" with a deck of cards with numerals 0-100... Solitaire (omit face cards).

GOALS (Place Value):

To realize that a number's position determines its value.

To read or write any two digit number as tens and ones.

MATERIALS/ACTIVITIES:

See Mathematics in Our World - Book 1, Addison Wesley, p. 129-145,

See Mathematics Learning in Early Childhood, p. 139-150.

Manipulate objects that can be grouped by tens - popsickle sticks, pencils, unifix cubes, checkers.

Make "beansticks" to reinforce place value concepts. Single beans represent ones and tongue depressors with 10 beans glued to them represent tens (see Heath, p. 149).

Chip Trading activities - Book A.

Give students a set of "___tens___ones" cards. Have them bundle together sticks to represent number shown on card.

Let students demonstrate place value concepts with Unifix 1-Ten and Unit Trays and cubes.

Record tens and ones on a place value table.

Game - "I'm thinking of a number that has 5 tens and 6 ones. Who can write the number on the board?" The child who does continues the game by thinking of the next number.

"Concentration" game - Match cards showing 1 ten, 2 tens, 3 tens, with 10, 20, 30, etc.

EVALUATION: **Teaching Techniques**

Student Performance

ESTIMATION AND MENTAL ARITHMETIC (2 Weeks)

At the primary level, estimation is the process of refining guesses and narrowing choices. Children estimate quantity, size, distance and numbers. These activities can be correlated with mearurement and problem solving. Mental arithmetic refers to computation without pencil and paper.

GOALS:

To estimate (by looking) quantity, size and distance.

To estimate approximate locations.

To round off numbers to the nearest 10.

To do simple computations mentally.

MATERIALS/ACTIVITIES:

See Mathematics Learning in Early Childhood, P. 84-5, 151-2.

Estimate the number of jelly beans in a jar (or marbles, pebbles, ping pong balls, etc.). Start with a quantity in the teens; gradually increase the number.

Estimate distances, then "walk them off" (how many steps across the room, to the office, etc.).

Estimate which of two objects is longer, heavier, etc. and check by measuring.

Look for approximate locations on the number line. For instance, don't scan the teens when looking for 83.

Look for the approximate location of a page number in a book (beginning, middle or end).

Do "range" activities and various other estimating activities aith the calculator. See Keystrokes: Counting and Place Value and the PKY Calculator Research Monograph, Appendixes A & B.

Use the number line to teach rounding off numbers. Find 69. Is it closer to 60 or 70? When students can do this comfortably, ask them to round off numbers mentally.

"I'm Thinking of Three Numbers" - oral game. Say: "I'm thinking of 3 numbers that make 10. Two of the numbers are 3 and 4. What is the third number?" (When the children become adept at this, the child who answers correctly can "think" of the next numbers.)

Give a sequence of operations for children to perform mentally. Example: "Start with 10. Subract 5. Add 4. Subtract 3. add 2."

EVALUATION: Teaching Techniques

Student Performance

ARITHMETIC (15 weeks)

This strand consists of concepts, computation, application, and mastery of facts, with emphasis on concepts. Children develop understanding of concepts and learn basic skills involving numbers, addition, subtraction, fractions and money. Meaning is developed through the manipulation of objects.

GOALS (Number Concepts):

To identify equivalent sets by one-to-one matching.

To identify a set that has more or less than another set.

To identify the cardinal number of a set.

To associate numerals with sets.

To understand the ideas "one more than" and "one less than" in the progression of numbers.

MATERIALS/ACTIVIYIES:

See Addison Wesley Mathematics in Our World, Book 1 Ch. 1.

See Arithmetic Teacher, Sept. 1980, "Paper Dot Plates Give Numbers Meaning", p. 3-7. Lots of good ideas for working with sets and cardinal numbers. The dot plates are versatile.

See Mathematics Learning in Early Childhood, p. 131-3.

To reinforce sets and cardinal numbers - use "living sets" composed of children, flannel board add felt pieces, draw sets on the chalkboard, use counters (popsickle sticks, "teddy bears", pattern blocks, chips, Cuisinarie rods and cubes), Unifix Number Indicator sets, Value Boats and Stairs.

Provide numerous counting experiences.

Games which reinforce counting and numbers include Dominoes, Parchisi, Concentration.

Give each child a set of cards with numerals 0-9. Hold up 3 fingers and ask children to show the corresponding card. Let children take turns being the leader, or they can work in pairs.

Give each child a set of cards with numerals 0-9. Say, "Show me the number that comes after 3....before 8... Show me the number that matches the number of times I clap, blink my eyes, etc."

GOALS (Addition):

To understand that addition is joining together.

To understand + and = symbols.

To add 2 one digit numbers.

To add 3 one digit numbers.

To add a one digit and a two digit number without regrouping.

To add 2 two digit numbers without regrouping.

To understand the associateve law (4 + 3 = 3 + 4).

To master the facts through 10:

- Doubles (2 + 2, 3 + 3)
- Plus 1 (2 + 1, 3 + 1)
- Plus 2 (3 + 2, 4 + 2)
- Doubles + 1 (2 + 3, 3 + 4)
- Names for ten (6 + 7, 6 + 4)
- Plus 3 (5 + 3, 6 + 3)

GOALS (Subtraction):

To understand that subtraction is taking away.

To understand - and = symbols.

To subtract 2 one digit numbers.

To subtract a one digit number from a two digit number without regrouping.

To subtract 2 two digit numbers without regrouping.

To understand that addition and subtraction are inverse operations (5 + 4 = 9 and 9 - 5 = 4).

To master the facts through 10.

MATERIALS/ACTIVITIES:

See Mathematics in Our World, Book 1, Addison Wesley, Ch. 2, 3, 4.

Concrete objects - Unifix Kit, Cuisinaire rods and cubes, counting frame, counting beads, counters (chips, cubes, teddy bears, popsickle sticks, beans, cereal), number line, hundred chart, flannel board and felt pieces, magnetic board and numerals, pegboards and pegs, calculator.

Calculator activities - see Keystrokes: Counting and Place Value and PKY Research Monograph #32.

See Mathematics Learning in Early Childhood, p. 161-190.

See Holt Mathematics, p. xii-xviii - Activities Resevoir.

Practice with pegboards while teacher tells story problems. Ex: "My Uncle Bill had 7 dogs (ch. put pegs in board) but 3 ran away (remove 3). How many dogs does he have now?"

Give each child several cards from a deck (omitting face cards). When the teacher holds up a numeral card, children look at their cards to see if they have a combination which adds up to the number shown.

Pasting activity - Prepare a ditto'ed grid and cut small squares in two colors. Object is for children to paste squares in the grid boxes to represent math facts. Ex: for 5 + 4, glue 5 reds and 4 blues.

Duplicate individual gameboards (see Heath, p. 82 or 128) and give each player a marker. In turn, children read a problem card (or roll dice and add) and give answer. The correct answer tells the number of spaces to move. First person to finish is winner.

Play Math Bingo.

See Mathematics Learning in Early Childgood, p. 180.

Facts practice games.

Flash card games:

"Around the World" - Flash a fact to two students. Whoever answers correctly first wins and moves to the next player. Object is to see how far you can go "around the world" (can be played orally, without flashcards).

"Standers and Seaters" - a team game. A row of children stand behind a row of seated children. Each pair competes to answer math fact first. Winner keeps card, and the team with the most cards wins.

"Beat the Clock" - 2 children play together. Race to see how many facts you know before timer runs out.

Timed Test - give orally allowing a few seconds.

Introduce written forms for fractions (when children can orally answer question about fractions, using fraction names, they are ready to write them). Explain that the bottom number tells how many parts there are and the top number shows how many are shaded.

Fraction game - make flashcards with figures divided into halves, thirds and fourths. Have two children stand. Flash a card. First to call out correctly 1/2 1/3, or 1/4, wins and is challenged by another student (to make it harder, show some figures that are divided into unequal shares; student must answer "none").

Draw figure and divide into parts. Shade one part and ask what part is shaded. Students write the fraction. Repeat with a variety of figures divided in different ways.

Most difficult connection is written to concrete. Draw a figure with three equal parts. Write 2/3. Say, "Show me how much this is".

Compare fractions. "Look at these two candy bars. If you got to have the shaded part of one of them, would you prefer to have 1/3 or 1/2? Which is bigger?

Card activity - Introduce the concept of a fraction of a set of objects. Ask students to suggest a way of dividing small deck of cards in two equally large parts (deal one at a time into two piles). Since there are the same number in each pile, each is 1/2 of the deck. Repeat for 1/3 and 1/4.

Stack books and ask student to show you 1/2. Repeat with other objects for 1/3 and 1/4.

GOALS (Money):

To identify and know the value of penny, nickel and dime.

To understand the relationship between pennies and nickels, nickels and dimes, pennies and dimes.

To identify the value of a collection of coins.

MATERIALS/ACTIVITIES;

Provide many experiences in counting money (start with largest coin).

Oral story problems. "I'm going to buy a piece of gum for a penny and some candy for a nickel. How much will I spend?"

Write various amounts on flash cards (8¢, 16¢, 24¢) and give each child play or real coins. Show a card and children must count out the correct amount of money.

Variation of above: Children play in pairs with the cards facedown. Take turns drawing a card and arranging the coins.

Children work in pairs with coins. One child lays out a collection of coins and the other counts it.

"Hidden Money" game - Hide a penny and a nickel in your hand. Day, "I have some money in my hand and I want you to tell me what coins I have. Here's a clue: I Have 2 coins and I have 6¢. What are the two coins?" Allow different children to be the leader and "hide" the money.

Give each child a collection of coins. Ask them to hold up a penny, a nickel, a dime. Write 35¢ on the board and have children lay out the correct amount.

Practice recognition of a group of coins. Write on the chalkboard: 3 dimes, 2 nickels, 4 pennies = _____¢. Let children use their coins to find the answer.

A play store, with a toy cash register, playcoins and articles to "buy" gives children practice with counting money and giving change in a real life setting.

Coin Collections - Perhaps a parent or other resource person has a hobby to share.

See Addison Wesley Book 1, p. 287-297.

EVALUATION: Teaching Techniques

Student Performance

Math Curriculum for Second Grade

The mathematics curriculum in second grade will be structured by the eight major strands listed below. Although these strands are organized in the order of their introduction, most of them will be intermingled with other strands in developing weekly lessons. The time assigned to each strand represents the amount of time focused on the strand throughout the year.

Strands

Problem Solving	5 weeks
Numeration and Place Value	7 weeks
Arithmetic	(12)
. Concepts and Principles	6 weeks
Computational Procedures	3 weeks
Facts	2 weeks
Applications	1 week
Estimation and Mental Arithmetic	2 weeks
Geometry, Measurement and Graphing	3 weeks
Spatial Visualization	1 week
Computer Literacy	1 week
Probability	1 week

Problem Solving

In this strand, children relate mathematical meaning to situations of their everyday living. Emphasis on problem solving is the basic foundation of our math curriculum. Problem solving will be integrated into all strands of our curriculum.

Goals:

To create a positive attitude toward math.

To encourage children to reason in solving problems.

To discover their own methods for solving problems.

To help children understand that it's acceptable to make mistakes in the problem solving.

To encourage students to listen to other explanations of problem solving strategies.

Students will solve problems by using these problem solving strategies:

- Make a list
- Look for a pattern
- Guess and test
- Draw a picture
- Break into parts
- Simplify

ACTIVITIES/MATERIALS

N.C.T.M. Yearbook, 37th edition, 1975, pp. 91-93

Keystrokes: Counting & Place Value pp. 24-32
pp. 43-46

Keystrokes: Addition & Subtraction pp. 20-22
pp. 32,62

Unifix

Chip Trading

Calculators

Tangrams

Geoboards

Microcomputer

Clocks

Money

Measures

Games

Houghton Mifflin Wkbk. - 2nd

pp. 41-42 problem solving/unit test

pp. 63-64 " "

pp. 107-108 " "

pp. 125-126 " "

pp. 165-166 " "

pp. 183-184 " "

pp. 209-210 " "

pp. 235-236 " "

Scott, Foresman Wkbk. - 2nd

p. 67

p. 105

p. 127-128

All materials and manipulatives will be used through the integration of problem solving into other strands.

EVALUATION: Teaching Techniques

Student Performance

Geometry/Measurement/Graphing (3 weeks)

Geometry: In this strand children will become aware of the shapes in their world. Geometry on this level incorporates recognition of simple figures, identification of points in space and a simple understanding of lines.

Goals:

To identify and name common shapes in his or her environment (circle, square, triangle, rectangle).

To identify a point as being a specific location.

To identify given points as "in", "on", and outside a two/three dimensional shape.

To identify a line segment.

To identify closed and open curves.

To introduce three dimensional figures (sphere, cube, cone, cylinder).

ACTIVITIES/MATERIALS

Attribute blocks

Shape kit

Geo blocks

Geo boards

Peg boards

Pattern blocks

Tangrams

Tossing game (bean bag)

Wire, soda straws, pipe cleaners for forming shapes

Mazes

String - make shapes

Wax paper - fold to make lines and line segments

Ruler

Isometric graph paper

Dot graph paper

Solids: cans, cartons, cone drinking cups, marbles, blocks

Houghton-Mifflin Wkbk Level 2 — Geometry

pp. 129-134 geometry

pp. 259-260 symmetry

Scott-Foresman — Geometry

pp. 69 (open-closed figures)

pp. 96 (geometric shapes)

pp. 131-133

pp. 229-231 (symmetry)

Measurement

The measurement strand will assist the children in the interpretation of their environment. (i.e. distance, liquid, time, temperature, weight)

Goals:

LINEAR--To provide experiences for children to measure familiar objects (non-standard, standard).

To discover, identify and manipulate the standard forms of linear measure (inch, foot, yard, centimeter, meter, and kilometer)

LIQUID--To discover and identify liquid measurement (cups, pints, quarts, gallons)

To discover and identify liquid metric measurement (½ liter, liter)

WEIGHT--To identify standard measures of weight (ounces, pounds, grams and kilograms)

TIME--To tell time by the hour, half hour and quarter hour.

To identify parts of a clock: face, hour hand, minute hand, second hand and minute marks.

To recognize seconds, minutes, hours, days.

CALENDAR--To be able to name months of the year.

To know numbers of days in a year.

To be able to name seasons.

To recognize a year as a period of time.

To apply calendar skills and knowledge.

To identify and recognize children's birthdays and holidays

TEMPERATURE--To discover and experience differences in temperature (freezing point, boiling point).

To identify the correct reading of a thermometer.

ACTIVITIES/MATERIALS

Arbitrary lengths (hands, sticks, string)

Measuring sticks (ruler, meter, yard, tapes, cuisenaire)

Many sized containers

Materials for pouring (sand, rice, beans, marbles)

Balance beam

Bathroom scale

Weights (metric/Eng.)

Scales

Clock stamp

Judy clocks

Individual Masonite Clock

Real clocks (digital)

Stop watch

Paper plates/brass beads/magic markers

Self-correcting clock games

Cassette tape - Telling Time

Calendars (posted all year)

Individual calendars for children (monthly grid)

Numerals (moveable)

Cardboard thermometers

Thermometers (centigrade/Fahrenheit)

Hot plate

Pot

Ice cubes

Cm. wall chart - measure height

Houghton-Mifflin

pp. 135-144 (length)

pp. 273-278 (liquid optional)

pp. 145-156 (time)

pp. 147-148 (calendar)

pp. 269-272 (time)

Scott-Foresman

p. 35 (cm.)

p. 37 (cm.)

p. 75 (cm.)

pp. 135-137

pp. 159-161 (distance)

p. 39 (telling time)

p. 115 (calendar)

p. 183 (quarter hour)

pp. 259-261 (liquid)

p. 25[illegible] (cm.)

Graphing

Children learn from pictures. Graphing can show growth, change, and difference in a pictorial representation. A better understanding of graphs may be developed by the construction and interpretation of simple graphs.

Goals:

To make graphs using manipulatives (building towers).

To show growth or change by making graphs (i.e. growth of plants, makeup of boys and girls, birthdays in a month).

Children will be able to acquire information and solve problems by interpreting graphs.

ACTIVITIES/MATERIALS

Graph paper

Unifix - value boats

Construction paper

Poster board

Scholastic Magazine

Houghton-Mifflin Wkbk 2

Graphing

pp. 17-18 (picture graphs)

pp. 181-182 (graphing)

pp. 205-206 (graphing)

Scott-Foresman Wkbk 2

pp. 17 (bar graphs)

p. 47 (shortest path)

p. 121 (pictograph)

p. 185 (graphing)

EVALUATION: Teaching Techniques

Student Performance

Spatial Visualization (1 week)

It is the purpose of this strand to develop skills to formulate mental images which will enhance learning. Carefully selected manipulatives will be used to provide opportunities for discovery and experimentation.

Goals: To see a form in space from different views (view from above, view from under, view from the side).

To recognize the same shape in different or changed positions.

To develop spatial visualization skills by providing a variety of experiences (puzzles, blocks, shapes, tessellations, etc.)

ACTIVITIES/MATERIALS

Pattern Blocks

Unifix cubes

Attribute blocks

Tangrams

Pic a Puzzle by Schadler - Seymour

Tangram Patterns by Thomas Foster

Parquetry blocks (tesselations)

Small parquetry designs

EVALUATION: Teaching Techniques

Student Performance

Probability (1week)

Probability gives opportunities for children to try,test, and confirm strategies. The pattern developed can predict a possible outcome.

Goals: To observe and participate in repeated activities in which a pattern is established. Direct children to make predictions. To direct children to check their predictions.

ACTIVITIES/MATERIALS

Toss a coin (heads or tails)

Spinners (1-6) (spin and determine a pattern)

Throwing a die (1-6) (throw, determine, predict)

Probable events to occur (cars on the road; weather)

Discuss statement and questions

N.C.T.M. Yearbook, 1975 pp. 86-87

Calculator

Microcomputers

Mathematics in Early Childoood N.C.T.M. Yearbook,

37th edition, 1975.

EVALUATION: Teaching Techniques

Student Performance

Computer Literacy (1 week)

It is important in our modern world for children to become knowledgable of computers. They will be living in a highly technical world.

GOALS: To become familiar with the computer (hardware, software, screen, keyboard, disc)

To provide experiences for "hands on" activities with the computer.

Introduce children to simple commands to develop readiness for programming.

ACTIVITIES/MATERIALS

Microcomputer (TRS-80)

Programmed software

Software for programming

Cassette recorder

Computers for Kids

Write name on computer

Learn computer commands (enter; run; list;edit)

EVALUATION: Teaching Techniques

Student Performance

Numeration & Place Value

This strand develops an understanding of the number system from 0-1000. The focus will be on the base 10 number system. Other bases will be introduced through simple manipulatives.

Goals:

To identify equivalent sets - one to one matching. (<,=,>)

To identify numbers of objects in a set of 100.

To count to 100 by 1, 2, 5, 10.

To recognize ordinal numbers 1 to 100.

To identify numbers which come before, after or in between (sequence).

_____10

12_____

18____21

To recognize patterns

To understand concepts of more, less, most, least

To be able to count to 1000 by 1, 10, 100

To recognize number words to 20

EVALUATION: Teaching Techniques

Student Performance

ACTIVITIES/MATERIALS

Number Line

Uniflx Cubes - Track, pattern boards, domino value boats

Hundreds Charts and Wood Frame

Abacus and beads

Work sheets (from various math work books)

Puzzles

Chip trading

Cuisenaire Rods

Blocks

Peg boards

Keystrokes Calculators Counting & Place Value

Keystrokes Calculators Addition & Subtraction patterns
pp. 56, 57, 58, 61

Overhead Projector

Patterns to Play on a Hundred Chart by Wallace Judd

Houghton-Mifflin Wkbk - Level II

pp. 1-4 (1-10)

pp. 5-12 (greater, less; order)

pp. 13-14 (numbers to 20)

pp. 15-16 (order)

pp. 19-20 (dot to dot)

pp. 75-80 (order to 99)

pp. 81-82 (ordinal)

pp. 123-124 Number patterns

pp. 237-238 (hundreds to 900)

pp. 239-244 (hundreds, tens, ones)

PP. 245-256 (1-999)

pp. 255-256 (dot to dot)

Scott-Foresman Mkbk - II

pp. 2-15 (0-20)

pp. 41-42 (order)

p. 45 (order, comparison)

p. 48 (number names)

pp. 77-89 (0-100)

pp. 93 (place value)

pp. 107-113 (order, place value)

p. 117 (1's, 5's, 10's)

p. 144 (count by 5's)

p. 147 (place value)

p. 181 (by 2's)

pp. 203-209 (0-1000)

pp. 219-220 (2's, 5's, 10's)

pp. 235-236

p. 238

pp. 241-243 (even/odd)

pp. 273-281 (0-1000)

Estimation and Mental Arithmetic (2 weeks)

Estimation is important to help students anticipate and make reasonable or approximate answers.

Mental arithmetic gives experiences in solving problems without pencil and paper.

Goals:

To help students to estimate nearest tens and hundreds.

To estimate size, length, time, money, value and distance.

To provide children with experiences which will let them calculate answers mentally.

ACTIVITIES/MATERIALS

Estimate the number of items in a container.

Estimate the length of the classroom, playground, etc.

Estimate the number of windows in the school; tiles in the floor; doors in the school.

Estimate heights and weights.

Round off numbers to the nearest ten and hundred.

Estimate time.

Maps (Scholastic Magazine)

Standard and non-standard measuring tools (i.e. rulers, hands, feet, yardsticks)

Hundreds chart/ Thousands chart

Numberline

Unifix track

Calculator - practice facts

Mathematics in Early Childhood N.C.T.M. pp. 84-85

Balance beam

Keystrokes: Calculator Activities for Young Students

Addition & Subtraction pp. 35-39

Stop watch

Isometric Graph Ppper

Dot Paper

EVALUATION: **Teaching Techniques**

Student Performance

Arithmetic

It is the purpose of this strand to encourage children to discover and to learn the properties and relationships of numbers.

Goals:

Whole Numbers

To add simple numbers on a number line.

To subtract simple numbers on a number line.

To introduce the commutative property with two addends.

To introduce basic facts related to tenness by using the associative property.

To practice and memorize basic facts with sums from 1-18.

To add and subtract whole numbers without regrouping.

To add one digit numbers without regrouping.

To add two digit whole numbers without regrouping.

To add three digit whole numbers without regrouping.

To add combinations of one digit, two digit, and three digit whole numbers without regrouping.

To add one digit whole numbers with regrouping.

To add two digit whole numbers with regrouping.

To add two digit and three digit numbers with grouping.

To subtract one, two and three digit numerals combinations without regrouping.

To subtract a one digit number from a two digit number with regrouping.

To subtract a two digit number from a larger two digit number with regrouping.

To subtract a two digit number or a three digit number from a three digit number.

To introduce multiplication of whole numbers using sets:

- recognize the number of sets
- recognize the number of objects in a set

To introduce multiplication of whole numbers using addition (3 X 3) (3 + 3 + 3).

To introduce simple division of whole number by separating objects into sets.

To develop an understanding and realization of the need and importance of math in everyday life.

Money

To identify symbols for cents and dollars.

To identify the decimal notation for dollars and cents.

To identify money values of the penny, nickel, dime, half-dollar and dollar.

To identify the money value of simple combinations of coins and dollars.

To develop an understanding of making change for simple purchases up to $1.00.

Fractions

To understand the concept of fractions:
1/2, 1/3, 1/4, one-half, one-third, one-fourth.

To apply the fraction concept to sets and regions.

To apply the use of fractions in everyday life.

ACTIVITIES/MATERIALS

Calculator

Microcomputer

Teddy bears

Chip trading

Number lines

Unifix (track)

Candyland

Parchesi

Abacus

Balance beam

Counting beads on wire

Colored blocks

Pegboards

Egg cartons

Pattern blocks

Fraction flannel boards

Real money/play money

Money cubes

Money stamps

Money games

Cash register (toy)

Change maker

Mail order catalogues

Monopoly

Play store

Tangle Tables - duplicating masters

Animal Math Riddles - dup. masters

Spooky Math Riddles - dup. masters

Whole Numbers

Keystrokes - Addition & Subtraction pp. 1-22

Houghton-Mifflin Wkbk 2

pp. 21-40	(facts to 7)	pp. 171-190	(facts to 18)
pp. 45-60	(facts to 10)	pp. 193-204	(2 place addition)
pp. 87-106	(2 place addition)	pp. 215-234	(2 place subtraction)
pp. 109-120	(facts to 10, 12)	pp. 247-250	(Add/ subtract 100's, 10's)
pp. 149-164	(facts to 15)	pp. 251-254	(3 place addition/subtraction)

Scott, Foresman Wkbk 2

pp. 19-33	(sums and minuends to 10)	pp. 187-190	(regrouping)
pp. 43-44	(sums and minuends to 10)	pp. 193-201	(addition with regrouping)
p. 46	(facts through ten)	pp. 211-218	(subtraction regrouping)
pp. 51-65	(sums/minuends to 14)	pp. 233-234	(addition/subtraction)
pp. 91-95	(review facts)	pp. 263-271	(regrouping)
pp. 97-104	(sums/minuends of 15-18)		
pp. 123-129	(sums/minuends to 18)		
pp. 140-143	(sums/minuends to 18)		
pp. 145-157	(addition with regrouping)		
pp. 167-179	(subtraction with regrouping)		

Whole Numbers

Houghton-Mifflin text

pp. 61-62 (dimes/pennies) Keystrokes: Addition & Subtraction pp. 23-34

pp. 69-74 (dimes/pennies)

pp. 121-122 (dimes/pennies)

pp. 165-166 (money)

pp. 183-184 (money)

pp. 207-208 (money)

pp. 279-280 (money)

Scott, Foresman Wkbk 2

p. 49 (pennies/nickels/dimes)

p. 118 (pennies/nickels/dimes)

p. 119 (quarter, counting money)

p. 221

Fractions

Houghton-Mifflin text

pp. 261-268

Scott, Foresman Wkbk 2

pp. 223-227 (regions/sets)

EVALUATION: Teaching Techniques

Student Performance

Math Curriculum for Third Grade

The following strands will make up the third grade mathematics program. The order in which they are listed does not necessarily indicate the order in which they will be taught. The number of weeks indicates the length of time for which the major focus will be on that strand. Other time during the year might also be spent on that strand. Calculators will be used throughout the program wherever appropriate.

Problem Solving	5 weeks
Geometry/Measurement/Graphing	4 weeks
Spatial Visualization	1 week
Probability	2 weeks
Computer Literacy	1 week
Numeration and Place Value	2 weeks
Estimation and Mental Arithmetic	2 weeks
Arithmetic	11 weeks
Concepts & Principles	8 weeks
Computational Procedures	4 weeks
Facts	2 weeks
Applications	1 week

PROBLEM SOLVING (5 Weeks)

GOALS:

MATERIALS/ACTIVITIES:

EVALUATION: **Teaching Techniques**

Student Performance

GEOMETRY/MEASUREMENT/GRAPHING

Geometry

GOALS:

Measurement

GOALS:

Graphing

GOALS:

EVALUATION: **Teaching Techniques**

Student Performance

SPATIAL VISUALIZATION

GOALS:

EVALUATION: **Teaching Techniques**

Student Performance

PROBABILITY

GOALS:

EVALUATION: **Teaching Techniques**

Student Performance

COMPUTER LITERACY

GOAL 3:

EVALUATION: **Teaching Techniques**

Student Performance

NUMERATION AND PLACE VALUE

EVALUATION: Teaching Techniques

Student Performance

ESTIMATION AND MENTAL ARITHMETIC

EVALUATION: Teaching Techniques

Student Performance

Arithmetic

GOALS:

EVALUATION: Teaching Techniques

Student Performance

MATH CURRICULUM FOR FOURTH GRADE

The following strands will make up the curriculum for fourth grade. They are listed in the order in which they will be presented. The number of weeks indicates the time of major focus on that strand. More time will be spent throughout the year in assimilation with other strands. The timing is 32 weeks because it allows time taken out for outside activities such as test taking, research, experiences, holidays.

	Weeks
Problem Solving	5
Spatial Visualization	1
Estimation and Mental Arithmetic	2
Geometry/Measurement/Graphing	6
Probability	2
Numeration & Place Value	2
Computer Literacy	3
Arithmetic	11
Concepts-Principles	4
Computational Procedures	3
Facts	3
Applications	1

EVALUATION: Teaching Techniques

Student Performance

PROBLEM SOLVING (5 Weeks)

In fourth grade the objective will be to introduce the problem solving strategies as a primary base for the math curriculum. A problem is defined as a situation in which you do not know how to find the answer. The strategies are ways to explore the problem to discover a solution. This strand will be the basis for the math curriculum. The problem solving strategies will be used throughout the year.

The strateties are:

Make a list

Guess and test

Find a pattern

Draw a picture or make a diagram

Simplify or break into parts

GOALS:

To develop profiency in the problem solving strategies.

To encourage exploration and discovery.

To realize there may be more than one "right" solution.

EVALUATION: Teaching Techniques

Student Performance

MATERIALS/ACTIVITIES:

Introduce problem solving attitude and define problem.

Introduce "Make A List" strategy, followed by practice.

Introduce "Guess and Test," followed by practice.

Brain Boosters

Tangrams

Keystrokes A & S, M & D

Numbers Range Problems

Calculators

Pencil/paper

Calculator

Aftermath

Introduce and practice "Find A Pattern"

Number sequences

Shapes paper

Horse Race

Introduce and practice "Draw A Diagram or Picture"

Example: In a make-believe horse race between five famous horses, Citation finished one length ahead of Seattle Sl w, Spectacular Bid finished ahead of Citation but behind Secretariat, and Man O' War finished four lengths ahead of Seattle Slew and one length behind Spectacular Bid. In which place did each horse finish?

Example: The distance between the tip of my fingers is 65 inches. Each of my arms is 24 inches long. How far is it across my chest?

Introduce and practice "Simplify or Break Into Parts."

Aftermath III p. 33

"Four on Four", Learning, April/ May 1981, p. 26

EVALUATION: Teaching Techniques

Student Performance

GEOMETRY/MEASUREMENT/GRAPHING (6 Weeks)

Geometry

Geometry is the study of shapes and planes, dots, lines and figures. The world is full of geometric lines and shapes for children to see. At this level geometry becomes more abstract by picturing the idea of dots, lines, rays segments. The reproduction of geometric ideas with a standard tool becomes an expectation for children. Tools used are compass, protractor, and ruler. However it is very important that children continue to have planned experiences manipulating, building, and placing geometric objects of all kinds.

GOALS: To introduce concepts relating to point, line, rays, line segments and planes.

To introduce and/or develop understanding of square, pyramid, polygon, circle, and similar, congruent and symmetric figures.

EVALUATION: Teaching Techniques

Student Performance

MATERIALS/ACTIVITIES:

Pattern blocks

Attribute blocks

Tangram cards/books

Aftermath

Math Match cards

Geo blocks

Great Shapes games

Compass

Protractor

Rotate games and manipulatives in small groups

Explore in small groups

Draw pictures using only 2 or 3 shapes

Cut symmetric shapes

Draw circles

EVALUATION: Teaching Techniques

Student Performance

Measurement

GOALS: To develop skills and understanding of measuring time, money, distance, weight, temperature and distance on maps.

GOALS/ACTIVITIES:

Activities with the calendar

Observe calendar patterns

Days, weeks, months

Measure of time with clock

Minute, hour, second

Before/after the hour

Clock arithmetic

Calculator

Set up center for linear and weight measure

Heights

Weights

Scales

Tape measures

Cubes

Books

Cloths

Ribbon

Rulers

Sticks

Objects to measure

Introduce map measurement problems

City maps

Graphing

Graphing is a part of measurement that records data in a pictorial form. Graphs are present in reading newspapers, textbooks and on television. At fourth grade, graphing will include use of bar, line and pie graphs. Plotting points on coordinates of positive numbers is introduced. Reading and constructing graphs from personal data as well as data in textbooks is important at this level.

To develop skill in recording data or understanding of a pictorial representation of a number idea.
To present ideas relating to the number plane.
To indroduce basic concepts of picturing numbers through graphing.

MATERIALS/ACTIVITIES:

Introduce graphs with favorite things bar graphs (pets, family size, foods, colors, TV programs, sports, hobbies)
Distance games
Graph baseball scores, football sccres, temperatwe
Show several kinds of graphs: bar, line, pie
Florida Atlas graphs

EVALUATION: Teaching Techniques

Student Performance

SPATIAL VISUALIZATION (1 Week)

In the fourth grade, spatial visualization is the strand most closely tied to problem solving. It includes the ability to see forms turning in space. Activities include turning, sliding and flipping objects. Tesselation is included in this strand.

GOALS: To develop the ability to recognize the same shape in different positions.

SKILLS/ACTIVITIES:

Introduction using Perception Blocks and Cards

Practice Activities

Aftermath Book II, p. 44

Aftermath Book III, p. 60

Unifix

Tangram Pieces

Overhead and Tracers (templates)

Dot Paper

Color Cubes

Soma

Pattern Blocks

EVALUATION: **Teaching Techniques**

Student Performance

PROBABILITY (2 Weeks)

A probability is a ratio or comparison of two numbers; one number representing total possible outcome and the other representing desired outcome. Probability is the idea of what may happen if you repeat the occurrences. What will happen if? What is more likely to happen? Newspapers, TV, Magazines all introduce ideas of "chance" "estimates" "prediction."

To introduce idea of no right answer but possible answers.

To help children develop skill in asking questions such as "Is it more likely to be x or y?"

The idea of predicting an answer.

The idea of chance (10% chance of rain).

The use of a calculator to estimate.

Introduce with spinners, coin filps, plotting points on a graph.

MATERIALS/ACTIVITIES:

Using two coins, have small group flip coins and record heads or tails (chance 1 out of 2).

Using a calculator do Keystrokes M & D pp. 39-49.

Using a spinner for a game spin, record number that turns up and compare records.

Set up examples board or center.

Bring in examples from newspaper that use "chance", "estimates", "prediction" statements or pictures.

Mathematics Learning in Early Childhood, NCTM, 1975, pp. 86-87

Textbooks

EVALUATION: Teaching Techniques

Student Performance

COMPUTER LITERACY (3 Weeks)

Computer literacy will include working with computers, playing educational games, and writing programs.

GOALS:

To become acquainted with computers as a tool.

To provide hands on experiences with computer learning.

To help students understand simple commands in order to develop a beginning program on the computer.

MATERIALS/ACTIVITIES:

TRS-80 Microcomputer

Become familiar with simple computer commands.

Play educational games (Distance Game)

Learn to write simple programs.

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Student Performance

NUMERATION AND PLACE VALUE (2 Weeks)

The numeration and place value strand will provide for study of our number system, place value in base ten and in other bases and faactions.

GOALS

To extend understanding of number system.

To develop a thorough understanding of place value concepts.

To provide practice in working with hundreds, thousands and millions.

To introduce billions and trillions.

To review and extend work with inequalities and other bases.

To use calculator to provide understanding.

MATERIALS/ACTIVITIES:

Systematic counting of place value.

Use unifix and chip trading whenever possible.

Review idea of many names for a number using small groups.

Review concepts of third grade.

Read numbers in small groups.

Review expanded notations.

Work sheets progressing from one through millions using expanded notations.

Write names for number digits.

Compare numbers with "greater than" and "less than".

Read and write words to show order of number.

Read and write fractional names of values (fourths, thirds, tenths).

Use fraction tables.

Make fraction kits with paper.

Decimal materials (calculators, money problems - Keystrokes A & S, pp. 23-30, other bases

Abacus

Pennies

Dominoes

Dice games

Aftermath IV. p. 18

Number Game pp. 19, 83

Name Game

Textbook

ESTIMATION AND MENTAL ARITHMETIC (2 Weeks)

Estimation is important to help students anticipate and make reasonable or approximate answers. Mental arithmetic gives experiences in solving problems without pencil and paper.

To estimate size, length, time, money, value and distance.

To estimate answers using all four numerical operations.

To provide many experiences in doing mental computation.

To use calculator to estimate when possible.

MATERIALS/ACTIVITIES:

Estimate time with stop watch.

How long is a minute?

How long will it take to???

Ex: Get a drink?

Write your name?

Read a page in your book?

Estimate length of books, tables, room distance.

Estimate cost of lunches, books, etc.

Estimate shoe size, shirt size, height.

Mentally calculate answers to some problems.

Increase difficulty of problems.

Teach tricks to compute mentally.

Maps

Rulers, meterstick (other standard tools).

Hands, feet, pencil

Unifix track

Balance beam

Calculator

Mathematics in Early Childhood, NCTM, pp. 84-86

Dot Paper

Triangle Paper

Stop Watch

Keystrokes A & S, pp. 35-39

EVALUATION: Teaching Techniques

Student Performance

ARITHMETIC (11 Weeks)

The content of this strand is traditional (computation with whole numbers and fractions). Emphasis will be on understanding operations rather than on drill in lengthy computations.

GOALS:

To develop further understandings of whole numbers, integers and rational numbers.

To develop an understanding of the concepts of addition, subtraction, multiplication and division.

To gain facility in the computation algorithms.

MATERIALS/ACTIVITIES:

Addition of whole numbers with and without regrouping in each place. The highest level of computation will be addition of four 4-digit numbers.

Subtraction of whole numbers with and without regrouping in each place. The highest level of computation will be a minuend of 4-digits.

Addition, subtraction, multiplication and division basic facts.

Relationships between addition and subtraction.

Meaning of multiplication and division.

Multiplication of whole numbers with multiplier of two-digit by 4 digit numbers.

Division of higher numbers with computation limited to one or two digit division.

Money, understanding the dollar and decimal notation.

Word Problems in all four operations of whole numbers.

Extension of number line to include negative numbers.

Fractional numbers - recognizing equivalent fractions

Fractional numbers, adding and subtracting like fractions.

Use of calculator in all operations.

Aftermath I, II, III

Keystrokes Set

Math Imagipation A, B, C, D

Monster Math A, S, M, D

Unifix

Fraction Bars

Chip Trading

Number Lines

Teddy Bears

Calculators

Scott, Foresman and Addison-Wesley Textbooks

First Week: Chip Trading - Bombers Game Three for One

Unifix - Extending tens

Calculator - constant key

Hundreds charts - patterns in addition

Second Week: Chip Trading

Worksheets & Calculator

Keystrokes A & S, pp. 1-10

Funtastic Calculation, pp. 7, 8, 9, 27, 30, 37

Keystrokes C & PV, pp. 39, 40, 41

Calculator

Third Week: Addition and Subtraction relationship

Missing addends

Try a File - Add. and Sub.

Chip Trading

Cross Number Puzzles

Find my rule, Scott Foresman, pp.24-25

Aftermath I Tinkertotals, p. 27-29

Aftermath I 16-19, II, pp. 29-39

Mathimagination A

Math Match

Calculator Activities, pp. 18-24,

25-30, 31-35

Cross Number Puzzles

Worksheets Heath 4th

Add. and Multiplication relationship

Skip counting

Keystrokes M & D, pp. 1-5

Calculator Activities 36-48

EVALUATION: **Teaching Techniques**

Student Performance

Math Curriculum for Fifth Grade

The following strands will make up the curriculum for fifth graders. The number of weeks indicates the time of major focus on that strand. More time will be spent through out the year in intergration with other strands. The timing is 32 weeks allowing for time taken out for outside activities such as test taking, activities related to other research projects, field trips, assemblies, and other interruptions of the regular instructional program. This listing does not necessarily represent the sequence in which the strands will be taught. The Problem Solving strand will receive major focus during the first five weeks of 1981-1982. A review of computational skills will be integrated into this period of time.

Problem Solving	5 weeks
Numeration and P. V.	2
Estimation & Mental Arithmetic	2
Geometry/Measurement/Graphing	5
Spatial Visualization	1
Computer Literacy	3
Probability	2
Arithmetic	12
Concepts-Principles 3	
Computational Procedures	5
Facts	2
Applications	2
	32 weeks Total

PROBLEM SOLVING (5 weeks)

The major thrust of the P. K. Yonge Math Curriculum is problem solving. The Problem Solving strand will be process oriented with emphasis on student explorations and identifying appropriate problem solving strategies. The problem solving process involves determining what to do when a procedure is not known. Therefore, if a child already knows how to solve a problem, he or she is not using problem solving strategies in working that particular problem.

GOALS: To develop five problem solving strategies

- Guess and test
- Draw a diagram
- Make a list
- Simplify the problem
- Look for a pattern

To demonstrate four essential steps in problem solving

- Understand the problem
- Devise a plan
- Carry out the plan
- Look back

To keep long computations to a minimum by allowing and encouraging the use of hand calculators

To encourage problem solving exploration

To encourage the idea that the solution to a real problem is not always unique

MATERIALS/ACTIVITIES

Problem Solving Attitude through Teacher Modeling & Student Interaction/Discussion

Week on each strategy in the beginning of the year

- Guess and Test
- Draw a Diagram
- Make a List
- Simplify the Problem
- Look for a Pattern

Daily and weekly problems on problem solving

- Problems worked out in small groups
- Individual work problems

Word problems and puzzles (brainteasers)

Techniques of problem solving (TOPS) card set

Brainboosters

Workbook - Worksheets

- Keystrokes (includes number range problems)
- Aftermath

Tangrams

Calculator

SOURCES: Purdue University: Problems by Wheatley

TOPS Cards (Creative Publications)

"The Problem Solving Process" by Grayson & Charlotte Wheatley (Purdue)

Iowa Problem Solving Project, Price Lab. School, University of Northern Iowa, Cedar Falls, Iowa 50613

An Agenda For Action by the National Council of Teachers of Mathematics, 1980

EVALUATION: Teaching Techniques

Student Performance

GEOMETRY, MEASUREMENT & GRAPHING (5 Weeks)

This strand will include exploring basic geometric figures and ideas, linear and volume measurement, time, and graphing.

Geometry - study of geometric figures and ideas

GOALS:

To consider shapes made up of rays (angles) and line segments (polygons); also circles

To construct geometric figures using compass and straightedge

To identify and name points, lines, line segments, rays, angles and parts of triangles

To recognize right angles, perpendicular lines and parallel lines

To use a protractor to measure and construct angles

To identify parts of a circle

To identify slides, flips, turns, and lines of symmetry

To identify subfamilies of polygons

MATERIALS / ACTIVITIES

Holt 5 Chapter 6

Graph paper

Tesselation Paper and Manipulatives

(Draw "Complete Tiled Floor" with one repeated shape)

Geoboards, Protractors and Rulers

Construction Materials

After Math Sheets

Geo Blocks

Great Shapes game

Pattern Blocks

Attribute Blocks

Tangrams

Cards, Math Match

MEASUREMENT

The concepts of perimeter, area, and volume are developed. Scale drawing and measurement of time are included. Emphasis is given to metric system.

GOALS:

To measure lengths to nearest centimeter

To become familiar with the metric system - linear volume, and temperature measurement

To find actual lengths and distances, given a measure on a scale drawing and the scale

To find perimeter of any polygon

To find the area of a rectangle, using the formula

To identify spheres, cylinders, cubes, rectangular prisms, and cones.

To find the volume of a rectangular prism using formula

To develop understanding of time

MATERIALS/ACTIVITIES

Calendar: Months, Weeks, Days, Year, Leap Year

Calculator Calendar - Casio Calculator Model A1-8S

Clock - Minute, Hour, Second

Time Arithmetic: Clock and Week-Day

Standardization Units of Measurement vs. Body-Units of Measurement

Worksheets

Maps with scale

GRAPHING - PICTORIAL REPRESENTATION OF NUMBERS (statistics)

GOALS: To consider graphs and charts

- picture graphs
- bar graphs
- coordinate points
- negative/positive coordinate graph
- broken line graphs

To read, construct and interpret graphs

To record data on a graph

MATERIALS/ACTIVITIES

Holt 5 pp. 336-347

Coordinate Graph Activity Book "Draw a Picture"

Battleship Game

Baseball "500"

Graphing Student Heights

Florida Atlas Graphs

Thermometer and Temperature Charts & Graphs

EVALUATION: Teaching Techniques

Student Performance

SPATIAL VISUALIZATION (1 Week)

The placement (arrangement, juxtaposition, flip, slide, etc,) of geometric shapes. These skills depend upon right hemispherical abilities (human brain)

GOAL: To encourage the use of right-hemispherical skills

MATERIALS/ACTIVITIES

Unifix

Geometric Analogies

Tesselations

Dot Paper

Tangrams

Rubiks Cube

Soma Cubes

Color Cubes

Overhead Projector

Tracers (Template)

Holt 5 Geometry

EVALUATION: Teaching Techniques

Student Performance

PROBABILITY (2 Weeks)

Probability is the ratio of successful outcomes to possible outcomes. It is a measure of outcomes on a scale where zero means impossible and one means certain.

GOALS:

To find the probability of a simple event (coin tossing, spinner game)

To find the probabilities of simple events, including the probabilities 0 and 1

To find the expected value of an event whose probability is known

To use the strategy try-test-confirm

To introduce the idea of chance (10% chance of rain)

MATERIALS/ACTIVITIES

Holt - 5 pp. 264-268

Use of Manipulatives - coins, colored spinners, playing cards, dice, children in the classroom

Book (Creative Publications)What Are My Chances?

Book A Grades 4-6 $6.95

Using Calculator & Keystrokes M & D pp. 39-49

Newspaper Statements that use "chance," "estimates," [illegible] "predict."

Microcomputers

EVALUATION: Teaching Techniques

Student Performance

COMPUTER LITERACY (3 Weeks)

This strand will deal with familiarization of the computer and knowledge of its impact upon our society.

GOALS: To introduce binary, hexadecimal (Computer Math)

To provide Hands-On learning experiences using microcomputers

To do elementary programming

To become acquainted with computers as a tool.

MATERIALS/ACTIVITIES

Video Cassette on using computers in the classroom

TRS-80 in the classroom (part-time)

Related articles in newspapers, reading books, etc.

Source: Computers For Kids

Word Commands: "Enter" "Run" "List" "Edit" etcetera

SOURCES: Mindstorms: Children- Computers, & Powerful Ideas by Seymour Papert

L C. 79-5200. 1980 ISBN 0-465-04627-4 Basic.

EVALUATION: Teaching Techniques

Student Performance

NUMERATION AND PLACE VALUE (2 Weeks)

This strand involves the study of our numbering system; its formation process and applications.

GOALS:

To work with numbers through hundred billions

To examine other numeration systems (Egyptian, Roman)

To study other bases - base Five, Binary, (Hexadecimal Optional)

To use calculator as learning tool

MATERIALS/ACTIVITIES

Write expanded and standard numerals

Identify the value of a digit in a standard numeral

Write standard numerals from word names

Write standard numerals from Roman Numerals

Compare numbers using <, =, >

Round numbers to nearest ten, hundred, thousand, ten thousand, hundred thousand, and million

Holt Mathematics - 5 Chapter 2

Classroom problems used for problem solving

Activity sheets

Calculators: Large Numbers (Using and naming)

Calculators: Expanded Numerals

Money

Counting activities

EVALUATION: Teaching Techniques

Student Performance

ESTIMATION AND MENTAL ARITHMETIC (2 Weeks)

Estimation is the process by which a student can determine a "reasonable answer". Mental arithmetic is synonymous with mental computation without pencil and paper.

GOALS:

To demonstrate rounding skills (10's, 100's, 100's) applied to arithmetic computations in practical problems

To provide opportunities for mental arithmetic, to include simple chain computations and estimations

To incorporate this strand into Problem Solving Strands

To provide calculator as tool to be used by students

MATERIALS/ACTIVITIES

Round whole numbers to nearest ten, hundred, thousand, ten thousand, hundred thousand, million

Calculator Range Activities

Holt Book 5 Chapter 2 Numeration - rounding

Any simple computations - written form or oral, drill sheets, classroom problems

Money problems

Practical problems

Here's the answer, what's the problem?

EVALUATION: Teaching Techniques

Student Performance

ARITHMETIC (12 weeks)

This strand encompasses the arithmetic algorithms and processes. The four components of the arithmetic strand are:

Concepts and principles

Computational Procedures

Facts

Applications

We will deal with the properties and relationships of real numbers.

GOALS:

To give less attention to performing long computations

To provide calculator as essential tool to be used for long computations

To give more attention to basic facts, performing mental computations and estimating results

To show examples of mathematical principles (Associative, Distributive, Commutative)

To incorporate arithmetic strand into problem solving

MATERIALS/ACTIVITIES

Learn basic facts in addition and multiplication. (To 9 + 9 and 10 X 10)

Adds - subtracts with regrouping for 3 or more digit numbers

Column addition with four addends up to 9,999

Use add-subtraction skills to solve word problems

Estimate sums and differences in computation and word problems

Solve word problems (application)

Use multiplication algorithm to find product of 2-digit times a 2-digit number

Use multiplication algorithm to find product of 2-digit times a 3-digit number.

Divide and check any whole number by a 1-digit division with or without a remainder

Divide and check a 2-digit and 3-digit dividend by a 2-digit division with or without a remainder (optional)

Solve practical word problems using multiplication and division skills mastered to this point

Write a mixed or improper fraction to describe fractional parts greater than 1

Write common fractions dictated or shown using pictures

Add fractions with common denominators

Read and write decimals to hundredths

Order a collection of decimals to the hundredths place

Add and subtract decimals to the hundredths

Multiply decimals to the hundredths place by whole numbers

Solve practical word problems using decimals

Flash cards, timed drill sheets, drill cards, calculators, teacher activities for drill in basic facts

Holt School Mathematics Books 4 and 5

Keystrokes

Miscellaneous printed materials used in Problem Solving Strand

Mastery Drills in Arithmetic

EVALUATION: Teaching Techniques

Student Performance

MATERIALS

Addison-Wesley Textbook Senior K - 5

Conner, Totsye J., An Investigation of the Use of Hand-Held Calculators By Students In Elementary School. Research Monograph No. 32, P. K. Yonge Laboratory School, Winter 1980.

Field Mathematics Program K - 5

Houghton-Mifflin Textbook Series K - 5

Larsen, Sally G. Computers For Kids TRS-80 Edition. Morristown, N.J.: Creative Computing Press, 1980.

NCTM Yearbook. Developing Computational Skills. Reston, Virginia: National Council of Teachers of Mathematics, 1978.

NCTM Yearbook. Teaching Statistics and Probability. Reston, Virginia: National Council of Teachers of Mathematics, 1981

Nelson, Doyal and Kirkpatrick, Joan. "Problem Solving," Mathematics Learning in Early Childhood. 1975. NCTM Yearbook, Reston, Virginia: National Council of Teachers of Mathematics, 1975.

Reys, R., Bestgen B., Coburn T., Schoen, H., Shumway, R., Wheatley, C., Wheatley, G., and White, A. (a) Keystrokes, Multiplication and Division. Palo Alto, California Creative Publications, Inc., 1979.

_____. (b) Keystrokes, Addition and Subtraction.

_____. (c) Keystrokes, Counting and Place Value.

_____. (d) Keystrokes, Exploring New Topics.

Scott, Foresman Textbook Series K-5

Aftermath I, II, III, & IV.

Mathimagination A, B, C, D, E & F

Arithmetic Games and Activities

Unifix Materials

Chip Teaching Program

Cuisenaire Rods

Thinklab

Legos

Geoboards

Fraction Bars

Tangram Materials

Perceptual Puzzle Blocks

Pattern Blocks

Battleship

Dominoes

Dice

Spinners

Tesselations

Konnectors

NOTE

Most of the resource materials which do not have a publisher listed are available from:

Creative Publications
P.O. Box 10328
Palo Alto, California 94303
(415) 968-3977

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Values, Beliefs and Goals Underlying the Program of P. K. Yonge Laboratory School, Resource Monograph No. 1, Gainesville, Fl: P. K. Yonge Laboratory School, University of Florida 1973.

Walter, Marion. "Geometry for Young Students in the 80's." Teacher 98, (February 1981): 44-49.

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Toffler, Alvin. The Third Wave. New York: Bantam Books, 1981.

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